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Preface

The International Research Network for Low Carbon Societies (LCS-RNet) was established in 2009 on the initiative of the G8 Environment Ministers Meeting (G8EMM). At their 2008 meeting in Kobe, G8 Environment Ministers recognised the need for each country to develop its own vision of a low-carbon society (LCS); what it would look like and how the transition might be achieved. This would contribute to the goal of cutting global emissions of greenhouse gases by half or more by 2050, to keep the rise of global average temperature below 2 ˚C – a level that is believed to prevent fatal impacts of the climate change to the majority of the eco-systems of the earth. Given this, the G8 Environment Ministers in Kobe strongly supported the establishment of the research network to help develop those visions and pathways towards LCS.

In October 2009, under the auspice of the Italian G8 Presidency, world leading researchers, who are working on various aspects of the LCS including scenarios, finance and technologies, gathered in Bologna, Italy, for the Inaugural Meeting of the LCS-RNet. Participants of that meeting held discussions on research needs for mid - and long-term targets and LCS scenarios, economic and technology policies, Green Growth, individual lifestyle changes, and cross-cutting issues. Amongst key findings from the discussions, the need for strong policy signals by governments to mobilise other actors especially for financing of low-carbon developments, and the need for collaboration amongst researchers and policy-makers to share scientific knowledge, were highlighted.

Five years have passed since the G8 leaders met at Gleneagles in 2005 to discuss climate change and the need for a transition of the energy policies to achieve low-carbon and sustainable societies. Since then significant progress has been made, thanks to the tremendous efforts of research and policy-making communities. Many industrialized countries and emerging economies have already set their mid- and long-term targets and are developing scenarios on how to achieve those goals. Thus, they are now entering the phase of policy implementation. However, also many countries are facing difficulties to gain public support for low-carbon policies, and many of them have still not fully recovered from the financial crunch of 2008.

The 2nd Annual Meeting of the LCS-RNet was held on 20-21 September, in Berlin, Germany. It was co-hosted by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety and the Federal Environment Agency, Germany, in cooperation with the Wuppertal Institute for Climate, Environment and Energy.

This report of the 2nd Annual Meeting of the LCS-RNet consists of three parts: a Synthesis Report, session summaries prepared by Chairs and Rapporteurs of each panel, and country briefs that were prepared by participants on a voluntary basis. It is important to note that the country briefs were prepared to share the information on LCS policies and research being carried out in those countries using their own capacity. The views expressed in the country briefs are not the official views of the respective governments.

In the Meeting, in addition to the role of governments, many participants emphasised the importance of understanding inter-linkages among different factors, as well as the role of science to explicitly aid the process of transition. These discussion points have been further elaborated in the Synthesis and Key Findings of the report.

Immediately after the Meeting, a drafting team of the Synthesis Report and Key Findings was set up with Dr Oscar Amerighi (ENEA), Dr Giulia Galluccio (CMCC), Dr David Garber (USEPA), Ms Isabella Kavafian (NRTEE), Mr David McLaughlin (NRTEE), Dr Rahul Pandey (IIM Lucknow), Dr Maria Jolanta Welfens (Wuppertal Institute), the Steering Group of the LCS-RNet, and Shuzo Nishioka, Kyoko Miwa, Wataru Machida, and Takako Wakiyama from the LCS-RNet Secretariat. We would like to express our thanks to Chairs and Rapporteurs of panels sessions, and all of those who contributed to the Meeting and the reports. We would like to express our special thanks to Dr David Garber, Ms Isabella Kavafian, Mr David McLaughlin, and Dr Rahul Pandey, who took leading roles in scientific editorial work to the Synthesis Report.

We also would like to express our sincere gratitude to the governments and government contact points to the LCS-RNet for their support and advice. Special thanks are due to Ms Sarah Rieseberg of the Federal Environment Agency, Germany, and Dr Stefan Lechtenböhmer of Wuppertal institute, for their strong leadership in planning the Meeting and for their hospitality in Berlin.

We would also like to express our special appreciation to the Federal Environment Agency, Germany, for their generous support to the LCS-RNet activities during 2010.

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Ten Key Findings

Followings are the major findings from the Second Annual Meeting of International Research Network for Low Carbon Societies held on 20-21 September 2010 in Berlin, Germany

- **Using the significant progress that has been made in LCS research and policy design, it is time to craft measures for implementation.**

  Developed countries have devised methodologies, analysed scenarios, and identified priority areas for policy. They are already in the implementation stage. Many emerging and developing countries are currently undertaking efforts to establish targets and policy measures, which vary depending on country-specific developmental and geographic factors. In both contexts, sharing knowledge and good practices of policies, institutions, and financial and technical instruments is desired. Supporting the advancement of scientific knowledge is crucial for such efforts.

- **All stakeholders need to be made aware that short-term costs are countered by longer-term benefits.**

  Raising stakeholder awareness about costs and benefits is a prerequisite to gaining their support and participation. This, in turn, requires transparency in policy-making and recognition of long-term, non-monetary, welfare benefits. Policy-makers and scientists need to effectively explain the impacts of policies, including costs. However, in explaining such costs, an emphasis should be placed on the trade-off between the short-term pain due to action and the loss of longer-term welfare from zero or inadequate action.

- **Inter-linkages among society's components must be understood in the effort to devise feasible and effective policy.**

  The real world comprises inter-linkages among various factors that cut across different sectors. Some examples are: land use for bio-energy, agriculture and forests; urban design and transport. A conscious effort is required by the scientific and modelling community to understand and explain such inter-linkages. Analysis of these inter-linkages would help to better coordinate top-down visions and policies with bottom-up actions.

- **Technologies and R&D alone cannot attain LCS.**

  The barriers to diffusion of new technologies are embedded in the systems of society, economy and the market. These barriers must be identified and removed in order to make progress. Examples of such barriers are: low awareness of consumers, producers, and policy-makers; inertia of existing institutions and infrastructures that inhibit penetration of new technologies; prevalence of mechanisms that incentivise high carbon technologies and lifestyles; and inertia of existing cultures.

- **Modelling implications and limitations must be correctly understood.**

  Short-term economic models would evaluate options based on several simplified assumptions about the behaviour of decision-makers and the dynamics of a market. In reality, a multitude of factors – a migratory labour market, particular land use policies, infrastructural inertia, informal economies – affect behaviours and outcomes that may not conform to those predicted by many models. Results of economic models must be interpreted with clear understanding of these limitations.

Ten Key Findings

- **Multi-level governance in a multi-level world is necessary for promoting LCS.**

  A new role of government is required in a world of multi-level governance, one that is characterised by multiple actors from business, communities and individuals. Stakeholders' participation in the decision-making process, as well as the government's active role as a facilitator and enabler, is crucial for the social acceptance of LCS. This change is exemplified by many cities around the world. Cities are acquiring an important role in promoting LCS, representing experimental sites for designing and implementing innovative policies and programmes.

- **International cooperation is central to the LCS transition.**

  Cooperation among countries is essential for designing tax policies, preventing carbon leakage, accelerating technology R&D and exchange, and reducing pressure on global natural resources. At the same time, international climate policies and frameworks of cooperation must recognise specific domestic goals, for example, challenges for sustainable growth in developing and emerging countries.

- **Mobilising private sector investment in a desirable direction is a key to achieving LCS.**

  Careful examination is required in promoting investment in existing technologies and industries that are expected to undergo rapid transition to achieve LCS. Financing existing technologies may cause future 'lock-in'. Therefore standard policy instruments may not be sufficient for LCS financing. The inter-dependence of political, economical and societal needs must be taken into account while evaluating investment options. Policy can play a role by linking investments with incentives, building competitive advantage of industries in the areas of energy-efficient and sustainable development based innovations.

- **Civil society participation is crucial to mobilising acceptance for LCS actions.**

  Civil society organisations are among a country's major stakeholders. They represent domestic development issues such as poverty reduction, sustainable development, local environment and climate change adaptation. They can play constructive roles, forming 'pressure groups' to mobilise mass awareness, acting as 'participants' in the target-setting process, in the designing and implementation of low-carbon projects, and as 'watchdogs'. These roles for civil society organisations need to be mainstreamed in international and domestic climate policies.

- **'Science in transition' can forge inter-linkages among issues, and more importantly, can be an agent of change.**

  In promoting transformative change, the inter-linkages among inherently complex issues must be clearly explained by scientists. Scientists have the responsibility to fill in the gaps that exist between policies, knowledge, and actors. In such a global transition, there must be mechanisms that use our wisdom to turn risks into opportunities. Timely delivery of knowledge that is needed by policy-makers and reaching out to the target audience and helping them to understand risk management during a complex, but necessary, transition are crucially important roles of science.

Synthesis of Findings

Section 1 States of LCS: Status, research, plans and actions for achieving low-carbon societies

Long-term and mid-term targets

GHG reduction targets provide core focus for developing and implementing LCS transition plans.

At Copenhagen, in December 2009, it was reiterated that deep cuts in global emissions are required based on the scientific assessment provided by the IPCC Fourth Assessment Report with a view to keep any rise in the global mean temperature below two degrees Celsius above pre-industrial level to prevent dangerous anthropogenic interference with the climate system. To meet this goal, it is also recognised that the world faces the challenging objective of deep-cuts of global GHG emissions*. While a mid-term global target does not yet exist, several countries have put in place their own and are already exploring the feasibility of meeting both mid- and long-term reduction goals by the following:

- estimating socio-economic impacts of policy options through 2050;
- estimating energy service demands;
- exploring innovations for energy demands and energy supply; and
- quantifying energy demands and energy supply to estimate CO_2 emissions.

A clear recognition by most developed countries exists of the technological and policy challenges to achieve significant GHG emissions reductions while, at the same time, satisfying expected rising demand for energy services through 2050. In order to achieve these goals, actions need to be taken immediately. These actions involve structural changes to the industrial sector, investments in infrastructure, and behavioural change among energy consumers. Governments will need to take a leading role in promoting a common vision towards a low-carbon society and in implementing measures that translate the potential for emissions reductions into reality.

Role of technology

Technology development and deployment is crucial to successful LCS transition.

More radical technological change than currently expected is needed to attain a low-carbon society. This involves not just the development of new or groundbreaking clean energy technologies, but the rapid deployment of as many useful technologies as feasible, taking into account the different stages of development of each technology. Countries need to consider how to overcome the barriers that prevent market-access for clean technologies. These barriers are not just commercial. Political, socio-economic and technological barriers exist and can be overcome with a diverse set of policy actions that encourage research, development and demonstration of new technologies, network creation, community involvement in policy-making, alternative lifestyles, education, policy initiatives, subsidy reform, taxes, and incentives. To

*FCCC/CP/2009/11/Add.1 IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

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market clean technologies, successful collaborations among research centres, universities, and the private sector can be a powerful tool. Already countries are investing in developing clean technology sectors for their economies. A significant global development is the growing economic importance of new clean technology sectors, such as the solar and wind energy industries, in generating revenue and creating jobs for the future.

Role of research

Quality, accessible research is needed by policy-makers for developing effective LCS strategies.

Science-based evidence and findings form the basis for effective policy-making and are influential in determining world-wide investment priorities for the transition toward a low-carbon society. Funding for science and other applied research is important to identify and design the appropriate path of transition. Research is typically focused around three main areas:

1. climate observation and modelling;
2. vulnerability assessment and socio-economic impacts of climate change on human health, human settlements, ecosystems, agriculture, and costal zones; and
3. mitigation potential assessment, energy system scenarios, and the economic impact of energy and environmental policies.

The common challenge confronted by all three areas is that of uncertainty as it relates to the anthropogenic effect on the climate system and to the impact of climate change on living systems. A variety of research centres are engaged in filling this gap with scientific research.

Green growth and governance policies aimed at the transition to a low-carbon society

Effective green growth policies require effective governance mechanisms to engage stakeholders and induce changes in business and citizen behaviour.

The possibility of a sustained recovery from the current economic crisis in conjunction with a transition to a low-carbon society largely depends on the policies implemented at different levels of government. The current context necessitates the combination of a short-term economic solution with a long-term focus on environmental and climate change issues.

Policy-makers should frame the risks and costs of climate change as opportunities to promote policies that achieve mid-, and long-term emissions reduction targets and generate new prosperity. Public funding for R&D and green public procurement can play a crucial role in stimulating green innovation. For example, many developed and emerging countries have approved fiscal stimulus packages that include public investments in green infrastructure (public transport, low-carbon energy production, smart electricity grids). At the same time, policies that put a price on carbon (e.g., taxes on GHG emissions) send the appropriate economic signals to firms and investors, also raising consumer awareness and altering consumer behaviour. Tradable permit systems (such as the EU Emission Trading Scheme) have led to the emergence of a market for the 'rights to pollute.' The auctioning of emissions allowances generates revenues that are often used to finance climate initiatives and clean energy R&D and innovation.

International cooperation is central to the LCS transition. Governments are called on to collaborate on several issues: on designing green tax policies, on preventing the risks of firm relocations (carbon leakage) and subsequent job losses, on technology R&D and exchange, and on reducing pressure on scarce global resources. At the same time, national policies are constrained by the internal realities of the sovereign state. It is therefore crucial to recognise the specific situation and needs of each country. For example, the growth needs of developing and emerging countries – compared to developed countries – needs to be identified and understood in order to devise appropriate strategies that effectively balance development perspectives and carbon emissions reduction targets.

Policies devised and implemented at the local level (region, province, city, and municipality) are key drivers for the transition to a low-carbon society. Progress towards low-carbon solutions at the local level has been greater in many instances than on a national scale. It is increasingly being seen as a necessary step towards a broader nation-wide low-carbon transition.

A sustained transition to a low-carbon society will require a mix of traditional and new policy instruments and innovative governance mechanisms. Designing the appropriate incentives for different stakeholders

in society – business, consumers, civil society, and governments – to change behaviour and reward low-carbon solutions will require more and different types of engagement. Multi-level, multi-actor, network-based processes involving the political, economic, and civil society spheres will be necessary. In this new governance context, the traditional role of individual actors, businesses and governments is altered-specifically, the role of government transitions from that of a provider and controller toward that of a facilitator.

Regional and local initiatives

LCS ideas and implementation are flowing from and need to be grounded in, where people live.

The roles of regional and local authorities are of paramount importance to accelerating a transition to a low-carbon society. Local level authorities have more direct contact with constituencies, making them better positioned to build consensus on climate mitigation actions and to take meaningful actions. Cities, provinces, and regions are increasingly getting involved in climate change issues. In some cases, this is a consequence of the institutional context, such as the presence of a federal government that allows a degree of jurisdictional autonomy to territories. In other cases, this is due to a more locally-based level of interest. National level policy is needed to both support and coordinate the increasing number of local initiatives so they may be brought to fruition.

At the regional level, the development of climate change mitigation and adaptation plans and the establishment of GHG reduction targets, accompanied by the use of complex carbon market mechanisms, are already playing a fundamental role in building knowledge (sometimes consensus) and capabilities for subsequent national and global initiatives. These regional initiatives also exhibit great potential in stimulating clean technology development and deployment, creating new green jobs, and developing needed green skills. The most comprehensive sub-national plans present a sectoral and integrative approach that distinctly treats the particularities of different key areas like energy efficiency and renewable energy, transportation, buildings, agriculture, waste management, public engagement and industry.

Other smaller efforts, such as bike sharing systems in many cities around the world, while at first appearing insignificant can, in fact, serve as a means to encourage behavioural change toward more sustainable lifestyles.

Community engagement remains a seldom-used but potentially influential tool for change; however, only a few local strategic plans have been the result of public stakeholder consultations. Among the main challenges of local action that remain are the lack of coordination with national governments and the lack of local financial resources.

Section 2 Stakeholder engagement, governance, and the role of citizens and cities

Stakeholder engagement and LCS policy development

A concerted effort is needed to raise awareness among stakeholders on the synergies between climate action and domestic development goals.

Most country-level low-carbon society studies point to roadmaps that require innovation and new practices in technology, infrastructure development, and consumer behaviour. Market forces alone cannot bring about these major changes in technologies and structures; so there is a need for state-level engagement with stakeholders.

All countries, especially emerging or less-developed economies, have multiple domestic development goals relating to energy security, sustainable development, local pollution, access to energy, access to water, biodiversity, economic growth and poverty reduction. These goals represent the interests of diverse stakeholders. Therefore, in order to align climate mitigation policy with domestic development goals and make tangible progress, there is a need to widen stakeholder participation in policy setting and implementation. This will, in turn, remove the barriers to implementing a low-carbon society and improve social acceptance of low-carbon technologies and infrastructures on both the supply and demand side.

For instance, on the supply-side, innovative financing mechanisms can support accelerated development,

commercialisation and diffusion of early-stage low-carbon technologies. Similarly, regulatory agencies at the national and local levels need to introduce appropriate support mechanisms. Such support systems can induce private companies to increase investment in low-carbon technologies which they may otherwise not do.

On the demand-side, different consumer and citizen groups must be engaged in the process of target setting as well as in designing, approving, implementing and monitoring low-carbon projects. New institutional structures should incorporate wide stakeholder participation. This will ensure explicit recognition of cross-sector and cross-community linkages and trade-offs, helping to find climate solutions that simultaneously minimise conflicts.

The role of governance in facilitating the LCS transition process

Stakeholder engagement leads to better governance mechanisms.

Governance mechanisms can create the appropriate stakeholder-specific incentives to gain support for the transition to an LCS. Such incentives must drive desired changes while resolving trade-offs between different stakeholder interests. Evidence-based decision making for climate action requires a strong linkage with the needs of decision makers who represent diverse societal interests. Governance mechanisms initiated by government itself are needed to forge this link.

Effective LCS governance processes need to be multi-level, multi-actor, and network-based involving political, economic, and civil society spheres. This will foster social acceptance of the imperative for action towards a low-carbon society and for the roadmap and other means to achieve it.

The new governance mechanisms must also emphasise awareness and capacity building among all stake-holders in the society. Political correctness must be replaced by a more candid explanation of trade-offs and outcomes to different sections of society and how these trade-offs are distributed over time. For instance, decision makers and experts need to clearly explain how climate mitigation options with high costs in the short run will reduce costs later. Domestic stakeholders should be made aware that such long-term benefits not only lead to avoided climate impacts but create co-benefits like energy security, sustainable development, local pollution reduction, and employment enhance-ment.

Cities and city-level stakeholders

Cities will play a major role in shaping the transition to a low-carbon society.

Low-carbon society impacts citizens, both where and how they live. Cities are crucial actors since they can directly influence the planning of key issues such as traffic, urban land-use, buildings, and waste management. Already, several cities have begun to autonomously act on self-determined targets that support a low-carbon society. For instance, local governments and municipalities in cities have set med-or long-term mitigation targets, identified demand-side and supply-side options, made concrete action plans, and created governance mechanisms and institutions to involve relevant stakeholders.

While different departments within the city govern-ment play an important role in triggering climate change measures, pressure exerted on them by citizens, non-government organisations and political parties is essential.

Therefore, the role of cities, including the influence of those constituencies, needs to be mainstreamed in national and international level climate policy. However, as there could be many organisations representing the municipal level, certain mechanisms for effective coordination would be useful in this process.

Role of civil society

Civil society engagement is important to fostering broad-based societal support for LCS transitions.

Civil society organisations are among the major stakeholders who represent crucial climate related domestic development issues such as poverty reduction, sustainable development, local environment and climate change adaptation. A key challenge for climate policy is to identify synergistic interests of various civil society groups and economy-wide climate action goals, aligning mitigation strategies with them. This challenge entails several tasks - to identify major civil society interest groups and their concerns, possible climate mitigation solutions that can simultaneously address those concerns, potential barriers to implementing them, and strategies to overcome these barriers.

The roles of civil society groups in the transition towards a low-carbon society need to be mainstreamed in climate policy. These roles could be as:

- educating agents and pressure groups to mobilise mass awareness and support;
- participants in institutions and processes for target setting, and for designing, assessing and implementing low-carbon strategies and projects; and
- watchdogs to monitor the design and implementation of the projects that comprise this transition to a low-carbon society.

Section 3 Transitioning to a low-carbon society

Transitioning to an LCS

National LCS transition plans are becoming mainstream, but also need to become more holistic and comprehensive.

There is a fundamental consensus among most nations that the transition towards a low-carbon society needs to be achieved over the next 40 years in order to achieve global GHG reduction targets. The G8, the Major Economies Forum, as well as the Ad Hoc Working Group on Long-term Cooperative Action under the UNFCCC, concluded that countries should prepare national low-emissions (and development) plans. An increasing number of countries are already doing so.

This development matches the key messages of the 2009 LCS-RNet meeting in Bologna: differentiated mid- and long-term low-carbon plans are being considered and implemented to stimulate green economic growth and development. Apart from the need to secure appropriate financing, a rapid and targeted exploitation of technology is crucial, but will not create a low-carbon society on its own. Technological development needs to be complemented by society-wide changes in production and consumption patterns, only achievable through integrated government/industry/societal action that sends out the appropriately urgent price and policy signals to all sectors and actors.

Transitioning to a low-carbon society requires energy supply and demand approaches. Scenario studies demonstrate that national emission reduction strategies, on their own, are insufficient to implement a low-carbon society. There is also a need for rapid reduction of energy consumption. Although scenarios demonstrate a low-carbon society is achievable, the transition requires a fundamental and radical change over time from current practices. In light of this, the necessary global low-carbon transition is often referred to as the new industrial revolution.

To capture the transition accurately, it should be reframed in a more comprehensive and integrative manner to include a long-term vision for the whole-of-society encompassing the role of science, technology, governance, stakeholder engagement, institutional capacities, as well as citizens and consumers. In order to implement the necessary broad-based changes over time, such a perspective of a sustainable transition must be developed in a more innovative and integrative manner than traditional policy approaches.

Creation of a low-carbon society can no longer be restricted to basic climate policy issues that are resolved through technological means only. It is embedded in an over-arching framework of sustainability and long-term goals that account for factors such as demographics, migration patterns, resource constraints, consumption, and conflicts, among others.

Strategies for LCS need to be viewed as the core mechanism for future sustainable economic development. Emerging nations, in particular, envision LCS as an opportunity to capitalise on future global markets. Competitive advantage strategies in a low-carbon environment should foster eco-innovations, defined as creating 'novel and competitively priced goods, processes, systems, services and procedures designed to satisfy human needs and provide a better quality of life for everyone with a whole life cycle minimal use

of natural resources (materials including energy and surface area) per unit output, and minimal release of toxic substances.'

LCS as a positive future in which we want to live

Broad-based, bottom-up societal engagement and acceptance of LCS will be necessary.

It is important to make the challenges of the transition transparent and easy understood by society. Challenges include high up-front costs and uncertain returns on investment and structural changes, among others. However, there are some 'early mover' opportunities to transitioning to an LCS which need to be contrasted with the risks of inaction in the explanation and promotion of LCS to citizens and policy-makers.

A low-carbon society addresses both the need for a sustainable change in existing structures and a transformative change in one's belief system, meaning these will be 'bottom-up' changes from society as a whole. This broad understanding should be based in part on the legacy we want to leave for future generations, societies, and individuals.

Societal behavioural change is a key enabling factor for the sustainable transition. Altering consumer lifestyle can be achieved through various means, for example by creating incentives, setting best practices, and creating regulatory frameworks. There is a need to address both production and consumption systems. Furthermore, communication and education on sustainability play a crucial role in the transition

Section 4 Role of science: How can economics and social sciences advance an LCS?

Role of science

Science fills in gaps that exist amongst policies, knowledge, and actors.

Scientific advancements have enabled us to measure climate change, understand its causes, and predict its evolution. This understanding, of course, is incomplete, characterised by a noteworthy amount of imperfect knowledge, approximate theories, and a high degree of uncertainty. However, the policy-science interface is essential to design effective policy that meets environmental, economic, and societal goals as part of a low-carbon strategy.

In defining and designing a path towards a Low-carbon Society, other scientific disciplines have been mobilised. These sciences have helped us to design and analyse climate change solutions that are both sustainable and politically acceptable, while minimising financial and social costs. The natural climate sciences have defined the landscape, while economics and social sciences have helped to design the goal and the most appropriate path for achieving this goal.

The economics of climate change

Economics is necessary for the effective communication and portrayal of the issues at stake, the co-benefits, and the cost/savings of climate action or inaction.

The public discourse on climate mitigation and adaptation in many countries has focused on the issue of policy cost. Particularly in countries experiencing an economic slowdown, the public is concerned about the affordability of emissions reductions and other policies that encourage a low-carbon society. It is imperative that improved economic models are developed and utilised, capable of accurately portraying issues of concern to the general public.

Accounting for co-benefits of LCS policies is essential in economic modelling. There is a need for improving the ability of models to capture the 'spill-over effect' on growth and employment when moving to a low energy intensive economy. For emerging economies, there is a need to identify policies that would best deliver climate and development co-benefits vis-à-vis national goals like air quality, forestation, energy security, and energy access.

While the term, 'co-benefits' may seem to imply a less direct, secondary, or unintentional, positive impact of LCS policy, a robust comprehensive economic model is able to and indeed should include such benefits in producing valuations for impact analysis. The role of an economic modeller, in the construction of a framework for policy analysis, is to identify and represent the maximum feasible breadth and depth of costs and benefits. Benefits and formally derived co-benefits should be included equally.

Current economic modelling efforts need to improve in other areas. Climate change damage (or, equivalently, the benefits of avoided damage) is generally poorly captured by current policy economic impact models. For example, the 3% GDP growth rate assumption that is often used to construct business-as-usual scenarios may not accurately represent a world undergoing unconstrained climate change.

The result of not properly representing the economic damage of climate change is the overestimation of expected costs of LCS policies. The publication of such results tends to focus public dialogue on how much an LCS policy would cost rather than on how much an LCS policy would save the public in avoided climate change damage. Even in cases in which an impact analysis report states that the given study should be viewed as a cost-effectiveness study rather than a cost-benefit analysis, public dialogue seems to misinterpret estimates as being all-inclusive. The net economic impact is thus falsely perceived as an economic cost to society.

There is a need to accelerate advancements in modelling the economic impacts of climate change. There is much work being conducted around the world on estimating the 'social cost of carbon'. However the results have been preliminary, not yet having been widely integrated into major policy models.

Social sciences and societal transition

As a societal transition, the social sciences discipline can assist in guiding LCS development.

In various aspects of transitions, there are needs to advance understanding of the process of societal change. Social support of LCS and transition policy involves 'transition arenas' in which new narratives on climate awareness are created and diffused by key stakeholders. There is a need to understand the needs and roles of decision makers who set priorities and are forced to make trade-offs under political constraints - this being the political economy perspective. One of the major findings of the panel on the important role of cities in creating low-carbon societies was the need for research on how to create a participatory environment that efficiently engages and processes the ideas of citizens and other stakeholders.

While these scientific perspectives have often been made distinct from economic analysis, they are, in fact, all necessary parts of one inter-disciplinary approach necessary to translate a prudent LCS policy idea into actionable policy. The importance of inter-disciplinary scientific analysis for the LCS field is clear. To further sustainability science, there is a need for theory and methods that are integrated, holistic, and systems-oriented, rather than fragmented and specialised. Continuing efforts are required to link the various frameworks of analysis, including that of economic analysis, in order to maximise the probability of transforming good policy ideas into action.

Using science to advance LCS transitions

Scientific knowledge of various types are needed in confronting the climate change.

Predictive climate sciences are young, less than 50 years. Economics and social sciences have been analysing climate change issues for an even shorter period. The discipline of social science, in general, has attempted to understand the very fast evolution of our societies over the past 20 years. Envisioning the future is a difficult task. These sciences of human behaviour are naturally characterised by a higher degree of uncertainty than the physical sciences. However, their use is essential in identifying a feasible transition to a low-carbon society, assisting us in avoiding potentially catastrophic events.

Climate change lies at the intersection of human behaviour and physical phenomena, an area that presents considerable challenge to the economics discipline. Much progress has been made in the field of environmental economics in terms of linking individual incentive to natural resources allocation.

Most crucial to confronting the climate change issue is to properly mix these different, and important, types of knowledge – the natural sciences, technological sciences, economics, and the other social sciences – translating them into stakeholder action and policy. This transformation from ideas to action is the main challenge of tomorrow.

Science-policy interface

The decision-making frameworks used by citizens, business, stakeholders, government policy-makers and the scientific community are all different.

Policy-making frameworks are usually guided by immediacy, short-term goals and deadlines that are not often science-based or loosely science-based. Thus, the scientific community has a responsibility to

make knowledge more accessible and policy-relevant for decision-makers to affect societal change. That includes a stronger reactiveness of science-based. Thus, the scientific community has a responsibility to make knowledge more accessible and policy-relevant for decision-makers do have, and means to develop modes of co-production of scientific and policy relevant knowledge between science and policy. To foster this an international 'academy for trransdicsiplinary transition research to a low carbon society' could be founded by the institutional members of the LCS-RNet. Overall, the communications between stakeholder groups, policy-makers, and the scientific community needs to be improved through new strategies and mutual understanding. The perspective of personalised socio-cultural frameworks - a system of beliefs, values, customs and behaviours shared by members of a society – to explain individual choices and social actions could be useful.

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Table of Presentations

Panel 1 - What policy-makers need from the LCS-RNet:	
Scope	Policy-makers on all levels of politics are confronted with the question 'how to practically implement LCS?' – the panel addresses: Knowledge needs for policy-making, barriers, issues of cooperation with other actors such as economic and social groups and low-carbon society as a mixed responsibility field. Policy-makers address the cooperation with different stakeholder groups and their demands from the scientific community.
	Chair: Carlo Carraro, CMCC, FEEM, Univ. of Venice, Italy
P1-1	*What policy-makers need from the LCS-RNet?* Franzjosef Schafhausen, BMU, Germany
P1-2	*Delivering GHG reductions and energy security: UK climate change and energy policies* Nafees Meah, DECC, UK
P1-3	*Mid- and long-term roadmap for global warming countermeasures* Yasuo Takahashi, MOEJ, Japan
P1-4	*EU low carbon strategy and research needs from the LCS-RNet* Jan Nill, EC

Panel 2.1 – National roadmaps on green development: An industrialised countries' perspective		
Scope	Scenarios – How to make scenarios work? How to understand policys and scenarios? What national strategies enable the necessary transitions and underpin the targets? Which strategies are being pursued to create visions of LCS and how is science for LCS involved?	
	Chair: David McLaughlin, NRTEE, Canada	Rapporteur: Isabella Kavafian, NRTEE, Canada
P2.1-1	*Scenarios – How to make scenarios work? Examples from the work of UBA* Harry Lehmann, UBA, Germany	
P2.1-2	*UK Energy 2050: the Transition to a secure low carbon energy system for the UK* Mark Winskel, UKERC/ Edinburgh Univ., UK	
P2.1-3	*Low carbon Russia: Perspectives after crisis* Igor Bashmakov, CENEf, Russian Federation	
P2.1-4	*Transition towards LCS in a second-best world* *Improving models and their use: An attempt in the French context* Jean-Charles Hourcade and Frédéric Ghersi, CIRED, France	

Panel 2.2 – Green Leaps for emerging economies		
Scope	How can emerging economies leap frog and move directly towards LCS? Are there examples of good practices for significantly increasing wealth, well-being, as well as sustainability and a small carbon footprint? What is the role of technology and knowledge transfer in this process? How can it be financed? How can researchers contribute?	
	Chair: P.R. Shukla, IIM Ahmedabad, India	Rapporteur : Rahul Pandey, IIM Lucknow, India
P2.2-1	*Climate change initiatives: Toward low carbon development* Syamsidar Thamrin, BAPPENAS, Indonesia	
P2.2-2	*Towards a low carbon future in Brazil: Voluntary goals for 2020* Emilio Lèbre La Rovere, UFRJ, Brazil	
P2.2-3	*Transition to low carbon economies in developing countries. Case study: Bangladesh* Nafees Meah, DECC, UK	

Panel 3.1 – National roadmaps on green development: A developing countries' perspective		
Scope	How do researchers view the institutions in developing countries in respect to LCS strategies? Are there transition plans under debate and in practice? What are the institutional challenges to formulate and pursue transformation?	
	Chair: Jean-Charles Hourcade, CIRED, France	Rapporteur: Eric Vidalenc, ADEME, France

P3.1-1	*Low carbon society: A green roadmap for India* P.R. Shukla, IIM Ahmedabad, India
P3.1-2	*Towards a low carbon future in Brazil: Voluntary goals for 2020* Carolina Dubeux, UFRJ, Brazil
P3.1-3	*Research and practice of low carbon society in China* Cai Bofeng, CAEP, China

Panel 3.2 – Green economy as a successful model for innovation of industrialised countries		
Scope	The panel will address issues of employment, independence from fossil fuels and benefits of sustainable economic practices in relation to the barriers and challenges of green economic policy instruments such as green investment and green taxation.	
	Chair: Bert Metz, ECF, The Netherlands	Rapporteur: Oscar Amerighi, ENEA, France
P3.2-1	*Green economy as a successful model for innovation in industrialised countries - Canada* David McLaughlin, NRTEE, Canada	
P3.2-2	*100 % renewable energy scenarios for Denmark* Kirsten Halsnaes, DTU Climate Centre Riso, Denmark	
P3.2-3	*Promoting green innovation and green growth:* *Policy instruments and challenges in terms of employment and human capital* Patricia Crifo, Univ. of Paris West and Ecole Polytechnique, France	
P3.2-4	*European Investment Bank* Gunnar Münt, EIB	
P3.2-5	*Governments, governance and the transition to a low carbon economy* Andy Gouldson, Univ. of Leeds, UK	

Panel 4 – Towards a research programme: How to come from here to there		
Scope	What can researchers supply to policy-makers? We wish to discuss the role of science for the transition to a sustainable low-carbon society and make suggestions towards a research programme.	
	Chair: Stefan Lechtenböhmer, WI, Germany	Rapporteur: Andy Gouldson, Univ. of Leeds, UK
P4-1	*The role of interdisciplinary science in the transition to a low carbon society* Jan Rotmans, DRIFT, Erasmus Univ. Rotterdam, The Netherlands	
P4-2	*The role of science in the transition to a sustainable low carbon society* Jill Jäger, SERI, Austria	

Panel 5.1 – Behavioural change: Models for sustainable consumption and production		
Scope	How can individual sustainable lifestyle 'trickle up' to overarching social paradigms? Presentations on research on understanding of lifestyle change and its potentials for LCS	
	Chair: Christa Liedke, WI, Germany	Rapporteur : Julia Nordmann, WI, Germany
P5.1-1	*Can sustainable lifestyles `trickle up'?* Birgit Munck-Kampmann, ETC/SCP	
P5.1-2	*Towards sustainable civilisation: How to bend the trend from unsustainable reality towards sustainable lifestyles?* Maria Jolanta Welfens, WI, Germany	
P5.1-3	*Transforming lifestyles and consumption patterns towards sustainable low-carbon society* Magnus Bengtsson, IGES, Japan	
P5.1-4	*An approach to sufficiency carbon society: A case study of Thailand* Sirintornthep Towprayoon, KMUTT, Thailand	

Panel 5.2 – A successful example: Communities and interest groups as promoters of LCS		
Scope	Stakeholders - If policy-makers set national policies, what is the role of non-governmental actors to bring LCS forward? Non-governmental actors are communities, social lobby groups, economic associations, universities etc. Can they generate 'please in my front-yard' attitudes?	
	Chair: Harriet Bulkeley, Durham Univ., UK	Rapporteur: Vanesa Castán-Broto, Durham Univ., UK
P5.2-1	*Innovation city* Anette Bickmeyer, E.ON/ Initiativkreis Ruhr, Germany	
P5.2-2	*Promotion of dialogue for policy making: Case of the long-term significant reduction in GHG emissions* Masanobu Ishikawa, Kobe Univ., Japan	
P5.2-3	*Solar water heater case study – Lwandle and Kuyasa, Cape Town* Steve Thorne, SSN, South Africa	

Panel 6.1 – Changing society: Social support of LCS and transition policy		
Scope	What kind of innovative strategies and measures are effective to implement policies and national plans of LCS in the real society? What are the barriers to implementing them? How can we overcome such barriers?	
	Chair: Mikiko Kainuma, NIES, Japan	Rapporteur: David Garber, EPA, US
P6.1-1	*Energy innovation milestones to 2050* Paul Ekins, Univ. College London, UK	
P6.1-2	*Transition governance for a sustainable low carbon society* Derk Loorbach, DRIFT, Erasmus Univ. Rotterdam, The Netherlands	
P6.1-3	*Towards low carbon society: Role of civil society* Rahul Pandey, IGSA Labs/ IIM Lucknow, India	
P6.1-4	*Barriers to low carbon growth: Lessons from EU* Roadmap 2050 Bert Metz, ECF, The Netherlands	
P6.1-5	*Brazil carbon market model* Ronaldo Seroa da Motta, IPEA, Brazil	

Panel 6.2 – Local governance towards a green society: How can cities act in a multilevel world?		
Scope:	Cities are the living space for the majority of people on the planet. They are the centres of production and consumption, of education and innovation. How can cities become eco-efficient and low-carbon, and how can local governments become forerunners of LCS? What is the role of global city networks? How far are cities the catalysts for 'national policy', 'behavioural change' and 'non-governmental actors'?	
	Chair: Jørgen Lund Madsen, ICLEI	Rapporteur: Hanna Scheck, WI, Germany
P6.2-1	*Copenhagen climate plan* Jørgen Lund Madsen, City of Copenhagen, Denmark	
P6.2-2	*Hannover Climate Alliance 2020 – On the way to a low carbon city* Astrid Hoffmann-Kallen, City of Hannover, Germany	
P6.2-3	*Rethinking cities in a post carbon society* Jacques Theys, MEEDDM and Eric Vidalenc, ADEME, France	

Panel 7 – Research cooperation and policy learning		
Scope	Mutual learning from each others' strategies for LCS – How far can international best practice fertilise national politics? Are the instruments and strategies developed so far, adaptable for developing nations? Presentation of country briefs	
	Chair: Jean-Pierre Tabet, ADEME, France	Rapporteur: Mark Winskel, UKERC, UK
P7-1	*Formulation of LCS* Kyoko Miwa, LCS-RNet Secretariat/ IGES, Japan	
P7-2	*Research drifts in the time of political transition: Japan's case* Shuzo Nishioka, LCS-RNet Secretariat/ IGES, Japan	

P7-3	*Country brief: Canada* Isabella Kavafian, NRTEE, Canada
P7-4	*Climate change: Where research meets policy in the United States* David Gaber, EPA, USA
P7-5	*Low carbon society in China* Cai Bofeng, CAEP, China
P7-6	*Review of long term visions and strategies for a sustainable Germany* Sarah Rieserber, UBA, Germany
P7-7	*Italian best practices towards a low carbon society* Part I: Giulia Galluccio, CMCC, Italy Part II: Sergio La Motta, ENEA, Italy

Panel 8 – Resume and Closing of the conference	
	Discussion based on Panels 1 and 7: Presentation of conference outcomes with two or three impulse statements
	Moderators: Jean-Pierre Tabet, ADEME, France / Stefan Lechtenböhmer, WI, Germany

Attached CD-ROM

Panel Summaries and Presentations

Country Briefs

CB1	*A dozen challenges to be tackled by low-carbon society research in Japan* Shuzo Nishioka, LCS-RNet Secretariat/ IGES, Japan
CB2	*Information briefs on strategies and research towards LCS in Canada* David McLaughlin, NRTEE, Canada
CB3	*Country brief on low carbon societies, United States* David Garber, EPA, USA
CB4	*Research and practice of low carbon society in China* Cai Bofeng, CAEP, China
CB5	*Review of long term visions and strategies for a sustainable Germany* Stefan Lechtenböhmer, Marie-Christine Grone, Ebru Acuner, and Sascha Samadi, WI, Germany
CB6	*Strategies and research towards LCS in Italy* Marinella Davide, Alice Favero, Giulia Galluccio, and Chiara Rogate, CMCC, Italy
CB7	*Possible UK path to an 80% reduction: Technologies and costs* Jim Skea, UKERC, UK

Acknowledgement

This Synthesis Report was developed with the aim of highlighting the linter-linkages of the findings with cross-cutting nature from panel discussions held during the 2nd Meeting of LCS-RNet in Berlin, Germany on 20-21 September 2010. One year has passed since the Inaugural Meeting of the LCS-RNet was held in Bologna, Italy, in October 2009. LCS research has made significant progress thanks to the dedicated effort of science and policy-making communities all over the world. Scientists and policy-makers gathered in Berlin this year, with the awareness that there are always new challenges to make further progress and the importance to reach out to various actors who actually make low-carbon societies being realised reality on the ground. The report summarises the key findings of the discussions in Berlin, thus carving out the future agenda for LCS research and policy-making. This will no doubt be of interest to all those who are carrying out LCS related research as well as to interested policy-makers and other stakeholders.

The scope of the Synthesis Report covers the following issues addressed during the Meeting:
- states of LCS: status, research, plans and actions for achieving low-carbon societies;
- stakeholder engagement, governance, and the roles of citizens and cities;
- transition to a low-carbon society; and
- role of science: how can economics and social sciences advance an LCS?

Further details of panels discussions, summaries of sessions and presentations, and country briefs prepared by participants as the background information for the meeting are included in the attached CD-ROM.

I would like to take this opportunity to express our gratitude to the contributors of the Synthesis Report and to those who contribute to drafting and editorial work of the report. I would also like to thank those who acted as facilitators and rapporteurs at the Berlin Meeting. Their panel summaries form the basis of the Synthesis Report.

Finally, I would like to express our gratitude to all participants of the meeting in Berlin for their contributions.

Shuzo Nishioka
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